

REPORT TO CONGRESS

ON

**NORTHEAST MULTISPECIES HARVEST
CAPACITY**

AND

**IMPACT OF NORTHEAST FISHING
CAPACITY REDUCTION**

PREPARED BY

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**Report on Northeast Multispecies Harvest Capacity
and Impact of Northeast Fishing Capacity Reduction**

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Executive Summary

The 1996 amendment to the Interjurisdictional Fisheries Act requires the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) to report annually to Congress on Northeast multispecies groundfish fishery harvest capacity as affected by the Northeast Fishing Capacity Reduction Program. This report covers the period December 1, 2001, to December, 1, 2002, and updates information provided in previous reports using methods for estimating maximum harvest capacity that were revised in December 2000. The report provides information on: The number of multispecies permits issued; the fishing capacity of vessels involved in the fishery; the number of days-at-sea (DAS) available to the fleet, with an analysis of their use; reductions in DAS due to the program; and the conservation benefits of the Fishing Capacity Reduction Program (FCRP).

Fishing capacity reduction in the Northeast was implemented in three phases. A pilot program started in June 1995 was completed in February 1996 with the removal of 11 vessels from the fishery. An expanded program was initiated in September 1996 and removed 68 additional vessels. In the spring of 2002, 245 multispecies permits were removed from the fishery.

The 1996 multispecies fishing year (May 1, 1996, through April 30, 1997) was the first full fishing year of the New England fishing capacity reduction initiative. In that fishing year, 1,810 limited-access permits were issued. The total number of DAS available to all limited-access vessels for the 1996 fishing year was 249,074. Two measures were used to estimate maximum potential fishing capacity represented by these vessels and DAS. The Capital Inventory Index (CII), a weighted vessel index, had a value in 1996 of 3,640 for limited-access vessels. The Estimated Fishing Capacity (EFC) measure had a value of 6,271 for these same vessels in 1996. The 1996 fishing year index values, permit numbers, and DAS allocations establish baselines for evaluating the impact of the FCRP and effort reductions in the Northeast multispecies fishery. The CII for all 79 retired vessels was 369, which accounted for a removal of 10% of baseline physical capital. The 1996 EFC for these vessels was 337, indicating a 5% reduction from the estimated baseline.

For the 1997 fishing year ending April 30, 1998, 1,786 limited-access permits were issued. This count excludes 11 vessels removed under the pilot vessel capacity reduction program but includes 68 vessels that were removed during the expanded buyout. The 68 vessels were counted because they held a valid permit during some portion of the 1997 fishing year. In 1997, the limited-access CII was 3,518, the limited-access EFC was 4,188, and the total limited-access allocated DAS was 160,667.

For the 1998 fishing year ending April 30, 1999, 1,638 limited-access permits were issued. This count excludes all vessels removed under both the pilot and expanded buyout programs. The 1998 CII was 2,987, the EFC was 3,790, and the limited-access allocated DAS was 146,483. This reduction was also a function of the Northeast Multispecies Fishery Management Plan (FMP) which reduced allowable DAS.

For the 1999 fishing year ending April 30, 2000, 1,652 limited-access permits were issued. The 1999 CII was 2,979, the EFC was 3,831, and the limited-access allocated DAS was 147,368.

For the 2000 fishing year ending April 30, 2001, 1,617 limited-access permits were issued. The 2000 CII was 2,896, the EFC was 3,718, and the limited-access allocated DAS was 144,669.

For the 2001 fishing year ending April 30, 2002, 1,658 limited-access permits were issued. The 2001 CII was 2,878, the EFC was 3,849, and the limited-access allocated DAS was 149,303. Since the permit buyout occurred at the end of the 2001 fishing year, 2001 becomes the baseline for tracking results of the permit buyout. The EFC for the retired multispecies permits was 549 in 2001 which indicates a 14% reduction from the total EFC of 3,849 in that year.

For the 2002 fishing year that will end April 30, 2003, 1,378 limited-access permits had been issued as of November 30, 2002. The preliminary 2002 CII is 2,764, the EFC is 1,468, and the limited-access allocated DAS number is 57,778. The reduction in number of permits, and the physical capital associated with those permits (even though the vessels could remain in other fisheries), is due to the permit buyout. The reduction in the EFC and DAS is from the combined effects of the permit buyout and the Settlement Agreement in Conservation Law Foundation et al. V. Evans et al.

In the 1996 fishing year, limited-access permit holders used a total of 51,329 DAS, for a utilization rate of 21%. In the 1997 fishing year, limited-access permit holders used a total of 46,801 DAS. As allocated DAS were 35% fewer in 1997 than in

1996, the utilization rate increased to 29%. In the 1998 fishing year, limited-access permit holders used a total of 50,201 DAS. Since allocated DAS fell an additional 9% from 1997 and used DAS were higher in 1998, the utilization rate increased to 34%. The decrease in allocated DAS from 1997 to 1998 was due to a decrease in the number of permitted vessels, including those removed by the expanded buyout, not to regulated reductions in DAS. Allocated DAS rose by less than 1% in 1999, to 147,368 days. This was due to activation of vessels with previously dormant DAS "history" permits. In the 2000 fishing year, allocated days were further reduced to 144,669 due to a reduction in the number of vessels. However, since used DAS increased to 53,494, the utilization rate increased to 37%. The utilization rate rose to 39% in 2001.

Conservation benefits of the capacity reduction program are difficult to distinguish from those resulting from implementation of management measures prescribed under Amendment 7 to the FMP and subsequent actions. However, available data indicated that substantial unused capacity remained in the Northeast multispecies fleet, even after accounting for physical capacity removed through the fishing vessel buyout program. The multispecies permit buyout addressed this concern and, in combination with the reduced DAS resulting from the Settlement Agreement, the unused capacity in the 2002 fishing year will be substantially less than in 2001.

Introduction

This report is the seventh in a series of reports to Congress on the FCRP. In the first four reports, fishing capacity in the Northeast multispecies fishery was measured using CII and HCI. In 2000, a national NMFS task force completed a review of definitions and measurement methods for estimating fishing capacity in U.S. domestic fisheries. As a result of this review, the analytical methods for estimating maximum harvest capacity in the Northeast multispecies fishery were revised in 2000. Specifically, Data Envelopment Analysis (DEA) was used to estimate fishing capacity in the Northeast multispecies fishery. DEA is a method endorsed by the task force, which has been widely applied to measure capacity in many different industrial sectors of the U.S. economy. Details of the DEA method are provided in Appendix I.

The current report presents preliminary information for 2002 and updates information provided in previous years. All information continues to reflect the DEA procedure for estimating harvest capacity. This report and previous reports respond to the following 1996 amendments to the Interjurisdictional Fisheries Act:

"... Section 308(d) of the Interjurisdictional Fisheries Act of 1986 (16 U.S.C. 4107(d)) is amended by adding at the end of the following paragraph: (7) With respect to funds available for the New England region, the Secretary shall submit to the Congress by January 1, 1997, with annual updates thereafter as appropriate, a report on the New England fishing capacity reduction initiative which provides -- (A) the total number of Northeast multispecies permits in each permit category and calculates the maximum potential fishing capacity of vessels holding such permits based on principal gear, gross registered tonnage, engine horsepower, length, age, and other relevant characteristics; (B) the total number of days at sea available to the permitted Northeast multispecies fishing fleet and the total days weighted by the maximum fishing capacity of the fleet; (C) an analysis of the extent to which the weighted days at sea are used by active participants in the fishery and of the reduction in such days as a result of the fishing capacity reduction program; and (D) an estimate of conservation benefits (such as reduction in fishing mortality) directly attributable to the fishing capacity reduction program." [Sustainable Fisheries Act of 1996, Section 402]

At the time of the 1996 submission, only the pilot phase of the vessel buyout was completed. The subsequent expanded vessel buyout had just been initiated and, as of December 1996, no

additional vessels had been retired. Additionally, the 1996 report contained only preliminary permit data and incomplete information regarding DAS utilization.

This report provides updated information for the 1996 through 2001 multispecies fishing years and includes information about vessels and permits removed by the capacity reduction programs. This report also provides preliminary data for the 2002 fishing year (May 1, 2002 - April 30, 2003).

The report begins with a brief overview of the Northeast multispecies fishery, some recent management actions, and the Northeast FCRP. This is followed by a brief discussion about permits held by the Northeast multispecies fishing fleet. The third section provides data on harvest capacity in terms of available capital stock and maximum potential capital utilization. The fourth section reports DAS utilization for the 1996 through 2001 multispecies fishing years. The potential conservation benefits of the Northeast FCRP are discussed in the final section.

The Northeast Multispecies Fishery and Management

The fishery for groundfish in the northeastern U.S. Exclusive Economic Zone has been managed under a Federal fishery management plan since 1977. The New England Fishery Management Council (Council) and NMFS have developed, implemented, and modified the FMP over this period. From 1977 to 1982, the fishery was managed by directly controlling the harvest of cod, haddock, and yellowtail flounder through catch quotas. During this period, the stocks began rebuilding from overfishing by foreign fleets. However, the U.S. fishing fleet subsequently increased. In 1982, catch quotas were removed and indirect controls on the harvest, such as gear restrictions, were implemented. The fleet continued to grow in both fishing capacity and number of participants. The groundfish stocks declined under increasing fishing pressure. In 1986, 10 more species were added to the original cod, haddock, and yellowtail flounder and the FMP became known as the Northeast Multispecies Fishery Management Plan (FMP). At present, 11 of the species the Council manages under this FMP are defined as "large-mesh species": Cod, haddock, pollock, yellowtail flounder, winter or blackback flounder, witch flounder, American plaice, redfish, white hake, windowpane flounder, and Atlantic halibut. The three "small-mesh species" are red hake, silver hake, and ocean pout.

Without direct controls on harvest, the principal groundfish stocks were severely overfished and the resources declined to low levels. In May 1994, NMFS implemented a major revision to the FMP (Amendment 5), as proposed by the Council, which capped the number of vessels in the fishery through a limited-access program and controlled the amount of time many vessels in the fleet could spend at sea. Gillnet vessels were restricted, to protect harbor porpoise, and hook vessels were limited in the number of hooks allowed. These measures were designed to end overfishing (as defined prior to the 1996 Sustainable Fisheries Act). Subsequently, the Council began to develop further modifications to the FMP to rebuild the depleted resource. Amendment 7 to the FMP was proposed by the Council in early 1996 and was implemented by NMFS in July 1996. More sectors of the fishery were included in the DAS control program, and additional harvest controls were specified.

Since implementation of Amendment 7, a number of modifications to the FMP have been developed through a series of 35 framework actions and 5 FMP amendments. These actions have implemented various combinations of indirect effort controls including trip limits, area closures, and gear restrictions. None of these frameworks changed DAS allocations, although some changes have been made in the accounting of DAS use, particularly for gillnet gear.

On December 28, 2001, the U.S. District Court for the District of Columbia (Court) rendered a decision on Conservation Law Foundation, et al. V. Evans (Case No. 001134, D.D.C, December 28, 2001) that required the NMFS to develop remedial measures to bring the FMP into compliance with applicable law. This ruling initiated a process that culminated in a Settlement Agreement that was eventually accepted by the Court (May 23, 2002). One element of the Settlement Agreement was the establishment of a freeze baseline for DAS allocations, and a 20% reduction in allocations from that baseline, to be implemented on August 1, 2002.

The freeze baseline was defined as being the maximum number of DAS used by a permit holder in any single fishing year from May 1, 1996 to April 30, 2001 not to exceed the current (FY2002 allocation prior to August 1, 2002) allocation. No vessel received a baseline allocation of less than 10 DAS. For limited access vessels not under the call-in system during the period May 1, 1996 through June, 1996, the vessels' DAS were based on vessel trip reports submitted to the NMFS before April 9, 2002. Otherwise, the DAS were based on the NMFS call-in system or, for vessels fishing with a vessel monitoring system (VMS), the DAS were based on tracking via the VMS unit. The resulting DAS

baseline was then reduced by 20% to obtain final allocations that would be in effect for the remainder of FY2002.

Since several aspects of the Settlement Agreement are intended to be interim actions that would be in effect until completion of Amendment 13 to the FMP, the DAS allocations implemented under that Agreement may be revisited in Amendment 13. For this reason, the substantial reduction in the EFC, seen in FY2002, may subsequently increase if DAS allocations are higher under Amendment 13.

The Northeast Fishing Capacity Reduction Program

Fishing capacity reduction in the Northeast was implemented in three phases. A pilot program was initiated in June 1995 and culminated in February 1996 with the purchase and disposal of 11 vessels having permits in the Northeast multispecies fishery. An expanded vessel buyout was initiated in September 1996, which removed an additional 68 vessels before completion in calendar year 1998. In the spring of 2002, 245 multispecies permits were removed from the fishery.

To be eligible for the vessel buyouts, applicants had to have active limited-access multispecies permits and to have earned 65% of their fishing revenue from landings of regulated groundfish in 3 of the 4 years from 1991 to 1994. Vessels were ranked in a reverse auction process where lower bids, weighted by groundfish revenue, were selected first. A bid's acceptance was contingent on the vessel being scrapped or committed to some non-fishing use, and on the surrender of all Federal fishing permits associated with that vessel.

The multispecies permit buyout, implemented in the spring of 2002, also used a reverse auction. However, bids were ranked by using a DAS weighted measure of fishing capacity. Of the 1,732 eligible permits, 502 bids, totaling \$99.2 million, were received. Funds of \$9.6 million were available to retire 245 permits. For this permit buyout there was no requirement to scrap the vessel or surrender other federal permits.

Northeast Multispecies Permit Categories

The permit counts used in this report require a few caveats. As mentioned above, the multispecies permit year runs from May 1 through April 30 and defines the fishing year. During the fishing year, open-access permits can be acquired at any time. Limited-access permits can be temporarily canceled by NMFS for lack of compliance with reporting provisions or other permit

requirements, and then reinstated. There may also be limited switching among permit categories from one year to the next to take advantage of slightly higher DAS allocations. A final consideration is the existence of "history" permits, latent permits that are not assigned to a current vessel, but that can be activated at any time. These caveats mean that the number of permits by category can vary from year to year and within a fishing year. The 1996 through 2001 permit data cover the full fishing years and are a complete account of all permits that existed from May 1, 1996, to April 30, 2002. The 2002 fishing year permit data were generated in November 2002 and should be regarded as preliminary due to the caveats above.

The FMP provides for two principal types of permits: Limited-access and open-access. These permit types are further subdivided into several different categories as defined under Amendment 7. The multispecies permit categories and the unique regulatory features of each are as follows:

Limited-Access

- A Individual DAS - based on the vessel's history.
- B Fleet DAS - an "average" number applied to all vessels in the category.
- C DAS Exemption - no limit on DAS for vessels 0-30 ft in length, but with a 300-lb per trip combined cod, haddock, yellowtail possession limit.
- D Hook-only - a limit of 4,500 hooks and fleet DAS. Vessels in this permit category can never change to another limited-access category.
- E Combination - for vessels with individual allocations in both the groundfish and scallop fisheries; assures that the vessel's total DAS never exceeds 365.
- F Large-Mesh Individual DAS - a slightly larger percentage allocation of their base DAS due to the lower mortality rate with the specified larger mesh.
- G Large-Mesh Fleet DAS - a slightly larger allocation than the standard fleet DAS, due to the lower mortality rate with the specified larger mesh.

Open-Access

- H Hand Gear Only - no limit on DAS, but with a 300-lb per trip combined cod, haddock, yellowtail possession limit.
- I Party/charter boat - no limit on DAS, but with recreational fishing rules.

- J Limited-Access Scallop Vessels - DAS limit depends on scallop permit. A 300-lb per trip combined cod, haddock, yellowtail possession limit for scallop vessels not fishing under a groundfish DAS.
- K Small-Mesh Species - no limit on DAS. Allows fishing for the three small-mesh species and requires zero possession of the 10 large-mesh regulated species.

The numbers of multispecies fishing permits by category are reported in Table 1. The first column of Table 1 denotes the permit categories as defined above. To facilitate comparisons of changes in numbers of permitted vessels over time, a baseline was defined as the number of permitted vessels prior to implementation of the pilot vessel buyout. The baseline (column 2 of Table 1) reflects all 1996 fishing year permitted vessels plus vessels removed during the pilot vessel buyout. Thus, the baseline may be thought of as being the number of permits and fishing capacity that would have existed during the 1996 fishing year, had no vessel buyouts taken place.

The third column in Table 1 reports the number of valid multispecies permits held during the 1997 fishing year. Due to the fact that the vessels removed by the expanded vessel buyout held a valid permit up until the time they were removed in 1997, permits held by these vessels are included in the reported 1997 permit data. Data for the 1998 fishing year are reported in column four of Table 1. Since the vessel buyouts were completed prior to the beginning of the multispecies fishing year, 1998 is the first year in which all vessels removed by the first two buyouts can be accounted for. Compared to the baseline of 1,810 limited-access permits issued in 1996, the total number of limited-access permits issued in the 1998 fishing year declined by 172 (10%). At least a portion of this decline (79 permits) was due to the vessel buyouts. Comparing the number of permits in 2002 to the 1996 baseline shows a reduction of 24%, which is the combined result of all three buyouts and some attrition.

Unlike the limited-access permits, there are no limits on the number of open-access permits that can be issued in a given year. During the 1996 fishing year, 1,625 open-access permits were issued. The number of open-access permits issued in 1997 increased by 376. In 1998, the total number of open-access permits issued was 1,887, and increased to 2,041 in 1999, 2,241 in 2000, and 2,383 in 2001. As of November 2002, 2,423 open-access permits had been issued for the 2002 fishing year.

Capacity

Capacity has both a stock and a flow component. Fishing capacity is jointly determined by the physical technical capability of fishing capital (the stock component) and the amount of time the fishing capital is applied (the flow component). Assuming that all variable inputs are used efficiently, maximum fishing capacity results when all fishing capital is applied over the maximum amount of available (or permitted) fishing time. The capital stock is represented by CII, while fishing capacity is represented by an EFC. Note that the EFC replaces the HCI used in the 1996 through 1999 reports.

Capital Inventory Index

The CII provides an estimate of the total amount of capital weighted by vessel characteristics existing in the Northeast multispecies fishery at any given point in time. The CII is computed as the product of vessel length in feet, gross registered tonnage, and main engine horsepower. The CII is independent of fishing time and resource conditions and so provides a mechanism to track inter-annual changes in physical capital. However, the index does not capture all relevant sources of technological change, such as gear modifications, electronics, or increases in captain and crew skill. As an indicator of changes in the available capital stock from one year to the next, the CII will decrease (increase) as numbers of vessels decrease (increase), or will increase as existing vessels upgrade subject to limits imposed under the FMP. Since permits are assigned to a vessel, the number of permit holders reported in Table 1 represents the total number of potential vessels. The CII reported in Table 2 is based on the same number of vessels, but is weighted by individual vessel characteristics.

As before, the baseline is constructed on 1996 fishing year permitted vessels plus the 11 vessels removed during the pilot program. The 1996 fishing year CII was 3,640 for limited-access vessels and 3,328 for open-access vessels, for a combined index of 6,968. The 1997 fishing year CII was 3,518 for limited-access vessels, a 3% decline compared to 1996. The 1998 limited-access CII declined to 2,987, a reduction of 18% compared to the 1996 baseline. The limited-access CII continued to decline through 2001 to 2,878, a reduction of 21% compared to the 1996 baseline. The preliminary 2002 CII is 2,764. These reductions are indicative of the combined effects of removing fishing capital through the vessel buyouts and attrition within limited-access permit categories.

Note that the 1997 CII was 17,953 for open-access permit holders. During the 1997 fishing year, an open-access Category K permit was issued to the Atlantic Star, a 369-ft, 6,700 horsepower, and 5,912 ton vessel. Due to Congressional action limiting fishing for Atlantic mackerel and herring by vessels in excess of 165 ft in length, the Atlantic Star's open-access permit was not renewed, resulting in the decline in the open-access CII for the 1998 fishing year. Nevertheless, maintaining open-access permit categories in the FMP plan will perpetuate the possibility for capital to flow into the fishery. Note that the 2001 CII for open-access vessels (3,811) was 15% higher than the 1996 baseline (3,328).

Estimated Fishing Capacity

While the CII measures the physical stock of available fishing capital, the EFC provides a measure of the maximum fishing capacity if the capital stock were fully utilized. The EFC is defined in terms of expected catch (in 100,000-lb units). The reader is referred to Appendix I for technical details regarding estimation of EFC.

Upon implementation of Amendment 7 to the FMP, all limited-access vessels were brought under the DAS program, except for Category C permits. An allocation of DAS places a cap on the maximum amount of time that can be used to fish for groundfish. The DAS allocations by permit category are reported in Table 3. Total DAS allocations for the 1996 baseline were 249,074. As noted earlier, the baseline includes DAS that would have been allocated to vessels purchased during the pilot program, even though these vessels were removed prior to the 1996 multispecies fishing year. In contrast, total allocated DAS for the 1997 fishing year were 160,667, representing a 35% reduction from baseline allocations. This reduction was due to the removal of vessels through the pilot vessel buyout, as well as the scheduled reductions in DAS¹ for all limited-access permit holders. DAS allocations for vessels that participated in the expanded buyout program are included for the 1996 fishing year. The total allocated DAS for 1998 were 146,483, a reduction of 41% from 1996 baseline levels. For 1999 through 2001, the total allocated DAS

¹ Vessels in categories A and E had their individual DAS allocations reduced by 20% in 1995, 18.8% in 1996, and 23.1 % in 1997. All vessels in categories B and D were allocated 190 DAS in 1995, 139 DAS in 1996, and 88 days in 1997. Category F vessels had their individual DAS allocations reduced by 23% in 1996 and 11.7% in 1997. Category G vessels were allocated 155 DAS in 1996 and 120 DAS in 1997. DAS allocations in 1998-2001 remained unchanged from 1997 levels.

rose somewhat due to activation of "history" vessels. Preliminary 2002 data show the sharp decline in DAS due, in part, to the permit buyout, but mostly due to the interim regulations resulting from the Settlement Agreement.

The EFC for each multispecies permit category is reported in Table 4. Since limited-access permit category C and all open-access categories are exempt from DAS controls, the EFC for these permit categories was determined from vessel trip report data. For these vessels, the EFC measures actual versus maximum harvest capacity. Measurement of maximum fishing capacity for the remaining vessels is subject to the same caveats described above for DAS allocations.

The EFC for the baseline was 6,271 for all limited-access permit holders and 37 for open-access permit holders, for a total of 6,308. For the 1997 fishing year, the EFC was 4,188 and 48 for limited-access and open-access permit holders, respectively. For limited-access permit holders in the 1997 fishing year, EFC declined 33% from the baseline. In 1998, the EFC fell an additional 6% from baseline levels. This decline was due to the aggregate effect of DAS reductions applied to all limited-access permit holders, the vessel buyouts, and attrition. EFC through 2001 rose slightly from 1998 levels. The EFC for open-access permit holders increased from 37 in 1996 to 58 in 2001.

Days-at-Sea Utilization

There are a few reasons why vessels may not fully utilize their DAS allocations. They may be fleet allocation vessels whose traditional fishing pattern may be less dependent on groundfish, even though they maintain a multispecies permit. Another reason is that a day-at-sea is defined as a full 24 hours of fishing. For example, a vessel that takes 88 12-hour trips would only use 44 of its DAS. In addition, there are some vessel owners who have simply chosen not to fish, but retain their multispecies permit.

Since DAS utilization can be calculated for only a complete fishing year, only the 1996 through 2001 fishing years are examined in the current report. Unlike in previous sections, only vessels that held valid limited-access permits for the entire multispecies fishing year were included in the analysis. This means vessels removed during the pilot program are excluded, since they were removed prior to the 1996 fishing year. All vessels that were removed during the expanded FCRP are included in the 1997 fishing year because they held a valid permit in that year. The 1998 fishing year is the first year in which all buyout vessels were absent. Utilization of DAS and EFC as

weighted by allocated and used DAS are reported in Tables 5 and 6, respectively.

A total of 247,454 DAS were allocated for the 1996 fishing year, while only 51,329 DAS, or 21%, were used. This utilization rate increased to 29% during the 1997 fishing year and to 34% during the 1998 fishing year. The utilization rate then dropped to 33% in 1999, but increased again in 2000 and 2001 to 39%. The increased utilization rate in 1997 was primarily due to reduced DAS allocations for the 1997 fishing year and not to an increase in the number of DAS actually used. In fact, used DAS declined in 1997 to 46,801 compared to 51,329 DAS in 1996. However, since 1997, there has been an upward trend in utilization rates. This is due to an increase in used DAS, which rose above baseline levels to 58,851 in 2001.

In all years, utilization rates differed considerably across permit categories, ranging from 88% for Category A to as low as 4% for Category D permit holders. Across all permit categories, the largest share of DAS was allocated to fleet (Category B) vessels. In this permit category, the 1997 DAS allocations were 40% below 1996 allocations, yet the DAS utilization rate increased to only 25% (from 14% in 1996). This difference is due to the fact that, while DAS allocations fell, utilized DAS rose only slightly. In 1998, allocated DAS fell an additional 4% in this category, used DAS continued to rise, and the utilization rate rose to 30%. After a slight decline in 1999, the upward trend continued through 2001, resulting in a utilization rate of 34%. A large potential still exists for effort expansion in this particular segment of the multispecies fleet.

Table 6 compares two measures of EFC, yearly capacity based on allocated DAS (EFC) against yearly capacity based on used DAS (EFC-used). The EFC utilization rate (EFC-used divided by EFC) should be approximately equal to the DAS utilization rate if vessel capacity among active vessels is representative of the population of vessels. For example, the DAS utilization rate for Category A permits was 77% in 1996 (Table 5) and the EFC utilization rate was 80% (Table 6). This means that utilization rates are roughly equivalent across all vessel sizes for Category A permit holders.

Impact of Fishing Capacity Reduction

In the short run, the conservation benefits of the vessel buyouts are difficult to sort out from those driven by the implementation of management actions prescribed under Amendment 7. Some of these regulations took effect in July 1996, but all were not in place until the following May. Since implementation, progress toward meeting the FMP objectives has been assessed

annually. Among the 35 Framework modifications enacted over this period, many conservation measures to protect specific stocks have been implemented. The 1998 fishing year marked the first full year in which vessels removed were not fishing. However, the changing management regimen makes an evaluation of the impact of fishing capacity reduction difficult.

There is no doubt that the vessels removed were more active than the majority of the remaining vessels. A summary of the buyout vessels' permits, DAS allocation, CII, EFC, and utilization rates is provided in Table 7. Data for both 1996 and 1997 fishing years include vessels retired during the expanded buyout. A total of 79 vessels were removed by both programs. As measured by the CII, 10% (369) of physical capital was removed in comparison to the 1996 limited-access baseline (3,640). As measured by the EFC, 5% (337) of fishing capacity was removed in comparison to the 1996 limited-access baseline (6,271). Of the 1996 fishing year DAS allocations, 12,169 DAS or 5% of total 1996 allocated DAS (249,074) were removed. Based on 1997 allocations, the expanded program removed 5% (7,664) of 1997 allocated DAS (160,667). For vessels that were bought out under the expanded buyout, DAS and EFC utilization rates were higher (in some cases much higher) as compared to the average for all vessels. For example, 1996 DAS utilization rates were 86%, 55%, and 89% for buyout vessels in permit categories A, B, and E, respectively. The average utilization rates for all vessels in comparable permit categories were 77%, 14%, and 27% (see Table 5).

Summary information of retired permits are shown in Table 8. The permit buyout removed 245 (15%) permits with a total of 20,805 allocated 2001 DAS, or 14% of the total. Fishing capacity, represented by the EFC, was reduced by 14% (an EFC of 549). While vessels weren't removed, the CII measure of physical capacity is still relevant because the physical capacity associated with the multispecies permit can no longer be used to catch groundfish. However, it can be used to harvest other species and, to a limited extent, multispecies under an open-access permit. Six percent of the total 2001 CII was removed by the permit buyout. The objective of the permit buyout was to target permits with latent effort. Therefore, the permits removed had average utilization rates of 2%.

Available data indicate that substantial capacity remains unused, or latent, in the fishery, even after the capacity removed by the FCRP is accounted for. The EFC utilization rate in 2001 (38%) was the highest for the 6-year time series covered in this report. While the permit buyout was successful in removing some latent permits, it is likely that some portion of available latent effort will continue to become activated as stocks recover. The 2001 fishing year is a new baseline for

evaluating the permit buyout in subsequent years. The reduction of allocated DAS resulting from the interim action under the Settlement Agreement will result in increased utilization rates. This will be an artifact of the reduced allocations and not, necessarily, from increases in used DAS.

Table 1. Number of Northeast Multispecies Permits (by Permit Category)

Permit Category	Baseline ¹ 1996 Fishing Year	1997 ² Fishing Year	1998 Fishing Year	1999 Fishing Year	2000 Fishing Year	2001 Fishing Year	2002 ³ Fishing Year
Category A	183	176	131	134	131	138	135
Category B	1,412	1,332	1,239	1,251	1,216	1,224	1,029
Category C	17	15	12	14	13	11	5
Category D	141	202	194	195	183	185	116
Category E	48	44	44	41	45	46	46
Category F	0	2	0	0	2	3	2
Category G	9	15	18	17	27	51	45
Total Limited Access	1,810	1,786	1,638	1,652	1,617	1,658	1,378
Open Access	1,625	2,001	1,887	2,041	2,241	2,383	2,423
Total Permits	3,435	3,787	3,525	3,694	3,858	4,741	3,801

¹ Includes vessels from pilot program

² Includes vessels from expanded buyout

³ Preliminary and excludes bought out permits

Table 2. Capital Inventory Index (CII) (by Permit Category)

Permit Category	Baseline ¹ 1996 Fishing Year	1997 ² Fishing Year	1998 Fishing Year	1999 Fishing Year	2000 Fishing Year	2001 Fishing Year	2002 ³ Fishing Year
Category A	1,122	1,063	726	729	750	767	757
Category B	1,991	1,950	1,762	1,761	1,627	1,658	1,514
Category C	1	< 1	< 1	< 1	< 1	<1	<1
Category D	57	64	58	64	57	61	33
Category E	468	428	432	417	438	440	422
Category F	0	7	0	0	3	4	3
Category G	1	6	9	8	21	27	35
Total Limited Access	3,640	3,518	2,987	2,979	2,896	2,878	2,764
Open Access	3,328	17,953 ⁴	3,462	3,549	3,927	3,811	3,645
Total CII	6,968	21,471	6,449	6,528	6,823	6,689	6,409

¹ Includes vessels from pilot program

² Includes vessels from expanded buyout

³ Preliminary and excludes bought out permits

⁴ 14,616 is attributed to the Atlantic Star

Table 3. Northeast Multispecies Vessel Allocated Days-at-Sea (by Permit Category)

Permit Category	Baseline ¹ 1996 Fishing Year	1997 ² Fishing Year	1998 Fishing Year	1999 Fishing Year	2000 Fishing Year	2001 Fishing Year	2002 ³ Fishing Year
Category A	29,266	21,747	16,289	16,337	16,337	16,918	13,071
Category B	196,268	117,216	109,032	110,000	106,656	107,624	38,775
Category C	E	E	E	E	E	E	E
Category D	19,599	17,776	17,072	17,160	16,104	16,280	2,398
Category E	2,546	1,987	1,930	1,831	2,019	1,899	1,271
Category F	0	141	0	0	313	462	193
Category G	1,395	1,800	2,160	2,040	3,240	6,120	2,070
Total Limited Access	249,074	160,667	146,483	147,368	144,669	149,303	57,778
Open Access	E	E	E	E	E	E	E

¹ Includes vessels from pilot program

² Includes vessels from expanded buyout

³ Preliminary, excludes bought out permits, and includes Settlement Agreement DAS reductions

E = Exempted from DAS controls

Table 4. Estimated Fishing Capacity (EFC) (in Units of 100,000 Pounds)(by Permit Category)

Permit Category	Baseline ¹ 1996 Fishing Year	1997 ² Fishing Year	1998 Fishing Year	1999 Fishing Year	2000 Fishing Year	2001 Fishing Year	2002 ³ Fishing Year
Category A	871	657	489	491	497	508	398
Category B	4,618	2,800	2,588	2,628	2,507	2,544	884
Category C	0.7	0.7	0.6	0.6	0.6	0.4	0.1
Category D	669	612	587	588	544	552	82
Category E	83	65	64	63	69	64	41
Category F	0	4	0	0	8	12	5
Category G	29	49	61	60	92	169	58
Total Limited Access	6,271	4,188	3,790	3,831	3,718	3,849	1,468
Open Access	37	48	48	49	54	58	62
Total EFC	6,308	4,236	3,838	3,880	3,772	3,907	1,530

¹ Includes vessels from pilot program

² Includes vessels from expanded buyout

³ Preliminary and excludes bought out permits

Table 5. Fishing Year Days-at-Sea Utilization (by Permit Category)

Permit Category	1996 ¹	1997 ²	1998 ³	1999	2000	2001
<u>Category A:</u> DAS	28,480	21,747	16,289	16,337	16,337	16,918
DAS Used	21,827	15,512	14,389	14,342	14,352	15,546
Rate Used(%)	77	71	88	88	88	92
<u>Category B:</u> DAS	195,434	117,216	109,032	110,000	106,656	107,624
DAS Used	27,922	28,706	32,319	31,294	34,804	36,953
Rate Used(%)	14	25	30	28	33	34
<u>Category C:</u>	E	E	E	E	E	E
<u>Category D:</u> DAS	19,599	17,776	17,072	17,160	16,104	16,280
DAS Used	778	1,421	1,781	1,763	1,849	2,281
Rate Used(%)	4	8	10	10	11	14
<u>Category E:</u> DAS	2,546	1,987	1,930	1,831	2,019	1,899
DAS Used	680	621	1,054	938	1,022	1,135
Rate Used(%)	27	31	55	51	51	60
<u>Category F:</u> DAS	-	141	-	-	313	462
DAS Used	-	0	-	-	274	390
Rate Used(%)	-	0	-	-	88	84
<u>Category G:</u> DAS	1,395	1,800	2,160	2,040	3,240	6,120
DAS Used	122	541	658	585	1,193	2,546
Rate Used(%)	9	30	30	29	37	42
<u>Total Limited Access:</u> DAS	247,454	160,667	146,483	147,368	144,669	149,303
DAS Used	51,329	46,801	50,201	48,922	53,494	58,851
Rate Used(%)	21	29	34	33	37	39

¹ Excludes vessels from pilot program because they were removed prior to the 1996 fishing year

² Includes vessels from the expanded buyout

³ All buyout vessels excluded

E = Exempted from DAS controls

Table 6. Fishing Year Estimated Fishing Capacity (EFC) Utilization (in Units of 100,000 pounds) (by Permit Category)

Permit Category	1996 ¹	1997 ²	1998 ³	1999	2000	2001
<u>Category A:</u> EFC	853	657	489	491	497	508
EFC-Used	680	478	438	434	433	474
Rate Used(%)	80	73	90	88	87	93
<u>Category B:</u> EFC	4,597	2,800	2,588	2,628	2,507	2,544
EFC-Used	662	663	744	701	768	806
Rate Used(%)	14	24	29	27	31	32
<u>Category C:</u>	E	E	E	E	E	E
<u>Category D:</u> EFC	669	612	587	588	544	552
EFC-Used	25	50	61	60	65	78
Rate Used(%)	4	8	8	10	12	14
<u>Category E:</u> EFC	83	65	64	63	69	64
EFC-Used	21	21	35	33	35	39
Rate Used(%)	25	32	67	52	51	61
<u>Category F:</u> EFC	-	4	-	-	8	12
EFC-Used	-	0	-	-	7	10
Rate Used(%)	-	0	-	-	88	83
<u>Category G:</u> EFC	29	49	61	60	92	170
EFC-Used	2	15	20	18	33	71
Rate Used(%)	8	31	32	30	36	42
<u>Total Limited Access:</u> EFC	6,231	4,187	3,789	3,830	3,717	3,850
EFC-Used	1,390	1,227	1,298	1,246	1,341	1,478
Rate Used(%)	22	29	34	33	36	38

¹ Excludes vessels from pilot program because they were removed prior to the 1996 fishing year

² Includes vessels from the expanded buyout

³ All buyout vessels excluded

E = Exempted from DAS controls

Table 7. Summary of Retired Vessels (by Permit Category)

Permit Category	Permits	Initial DAS	DAS Used	Rate Used	Initial EFC	EFC Used	Rate Used	CII
Pilot Study Vessels (1996 Fishing Year) ¹								
Category A	5	786	NA	NA	17	NA	NA	23
Category B	6	834	NA	NA	21	NA	NA	8
Total	11	1,620	NA	NA	38	NA	NA	31
Expanded Buyout Vessels (1996 Fishing Year)								
Category A	39	6,461	5,534	86%	197	176	89%	287
Category B	27	3,753	2,070	55%	92	53	57%	33
Category E	2	335	299	89%	10	9	90%	18
Total	68	10,549	7,903	75%	299	238	80%	338
Expanded Buyout Vessels (1997 Fishing Year)								
Category A	39	4,967	NA	NA	152	NA	NA	287
Category B	25	2,200	NA	NA	53	NA	NA	32
Category E	2	257	NA	NA	8	NA	NA	18
Category G	2	240	NA	NA	6	NA	NA	0
Total	68	7,664	NA	NA	219	NA	NA	337
¹ DAS allocations are estimated based on what pilot study vessels would have been allocated for the 1996 fishing year had they not been removed.								
NA = Not Applicable								

Table 8. Summary of Retired Permits (2001 Fishing Year) (by Permit Category)

Permit Category	Permits	Initial DAS	DAS Used	Rate Used	Initial EFC	EFC Used	Rate Used	CII
Category A	1	37	0	0%	0.66	0	0%	1
Category B	175	15,224	308	2%	373	7	2%	145
Category C	5	NA	NA	NA	NA	NA	NA	<1
Category D	64	5,544	201	4%	175	6	3%	27
Total	245	20,805	509	2.5%	549	13	2%	173

Appendix I: Modeling Maximum Harvest Capacity

The Capital Inventory Index (CII)

For purposes of this report, the technical attributes of fishing capital are represented by a Capital Inventory Index (CII). We calculate the CII as the product of a set of vessel characteristics. That is, the CII was computed as the product of gross registered tons, vessel length in feet, and main engine horsepower. The CII is independent of fishing time and resource conditions and so provides a mechanism to track interannual changes in physical capital. However, the index does not capture all relevant sources of technological change, such as gear modifications, electronics, or increases in skill.

Estimated Fishing Capacity (EFC) Measure

Data envelopment analysis (DEA) is one technique considered appropriate for measuring capacity from a technological-engineering approach (or perhaps more accurately, a technological-economic approach). Charnes, Cooper and Rhodes first introduced data envelopment analysis (DEA) in 1978. DEA extended the Farrell (1957) technical measure of efficiency for a single input, single output process to a multiple input, multiple output process. Since then, DEA has been used to assess efficiency in many different areas, ranging from the public sector to natural resource sectors such as the fishing industry.

DEA uses linear programming methods to extract information about the production process of each decision making unit (DMU, e.g. firm or fishing vessel). This is accomplished by calculating a maximal performance measure for each firm, and comparing this to similarly calculated measures for all other firms. Each firm's performance measure traces out a best practice frontier and all DMUs either lie on or below the frontier (Charnes et al.1994). A best practice frontier maps out the maximal level of output (or minimum input) that could be produced (or used) for any given level of input (output). Inefficiency for any DMU is determined by comparison to either another DMU, or to a convex combination of other DMU's on the frontier utilizing the same level of inputs and producing the same or higher level of outputs. The analysis is accomplished by requiring solutions that can increase some outputs (or decrease some inputs) without worsening the other inputs or outputs (Charnes et al.1994).

The one input, one output case can be expanded to cases involving

multiple inputs and multiple outputs. Charnes, Cooper and Rhodes (1978) proposed a method in which the multiple input, multiple output model was reduced to a ratio with a single "virtual" input and single "virtual" output by estimating a set of weights depicting each DMU in the most favorable position relative to

$$\text{Max}_{u,v} h_0(u,v) = \frac{\sum_r u_r y_{r0}}{\sum_i v_i x_{i0}}$$

s.t.

$$\frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \leq 1, \text{ for } j=0,1,\dots,n$$

$$\frac{u_r}{\sum_i v_i x_{i0}} \geq e, \text{ for } r=1,\dots,s$$

$$\frac{v_i}{\sum_i v_i x_{i0}} \geq e, \text{ for } i=1,\dots,m$$

other DMUs. In equation form, the model is as follows:

where:

y_{rj} = quantity of output r produced by firm j .
 x_{ij} = quantity of input i produced by firm j .
 u_r = weight for output r .
 v_i = weight for input i .
 e = small positive quantity

The estimated ratio provides a measure of technical efficiency for each DMU. However, there are an infinite number of solutions because if (u^*, v^*) is optimal, then $(\$/u^*, \$/v^*)$ is also optimal for $\$ > 0$ (Charnes et al. 1994). This problem is corrected by converting the ratio form into an equivalent linear programming problem as follows:

$$\text{Max}_{u,v} w_0 = \sum_r u_r y_{r0}$$

s.t.

$$\sum_i v_i x_{i0} = 1$$

$$\sum_r u_r y_{rj} - \sum_i v_i x_{ij} \leq 0$$

$$u_r \geq e$$

$$v_i \geq e$$

In order to measure capacity, Färe et al. (1989) proposed the following variation of the above linear programming:

$$\text{Max}_{\theta, z, \lambda} \theta \quad (1)$$

s.t.

$$\theta u_{jm} \leq \sum_{j=1}^J z_j u_{jm}, m = 1, 2, \dots, M, \quad (2)$$

$$\sum_{j=1}^J z_j x_{jn} \leq x_{jn}, n \in F_x, \quad (3)$$

$$\sum_{j=1}^J z_j x_{jn} = \lambda_{jn} x_{jn}, n \in V_x, \quad (4)$$

$$z_j \geq 0, j = 1, 2, \dots, J, \quad (5)$$

$$\lambda_{jn} \geq 0, n \in V_x. \quad (6)$$

where:

2	= the objective function or capacity measure;
u_{jm}	= the quantity produced of output m by firm j ;
x_{jn}	= the quantity of input n used by firm j ;
$n \in F_x$,	= inputs belonging to the set of fixed factors;
V_x	= inputs belonging to the set of variable factors;
8 _{jn}	= input utilization rate by firm j of variable input n ; and
z_j	= intensity variable for firm j .

Equations 3 and 4 are constraints on the fixed and variable inputs in the model. The term lambda (**8**) in equation 4 allows the variable inputs to be expanded or contracted for each DMU so that variable factors are not constraining. The fixed factors of production actively constrain the model. This is consistent with the Johansen (1968) definition which states "Capacity is the maximum amount that can be produced per unit of time with existing plant and equipment, provided the availability of variable factors of production is not restricted" (Johansen 1968, p. 52). The above model is estimated once for each DMU in the data set. DMU's whose value of theta is calculated to be one, are considered to be on the frontier, while those that are greater than one are considered to lie below the frontier. Capacity is then calculated for each product by multiplying theta by the observed output.

In DEA all products are expanded radially (proportionally). However, by incorporating slack values, non-radial levels can be obtained which are greater than radially expanded output levels (Walden and Kirkley, 2000). In a linear programming model, slack values are derived by converting inequality constraints to equality constraints and adding slack variables. A full discussion of slack values is given in Intriligator (1971). In order to incorporate slack values, the above model was modified following Walden and Kirkley (2000) as follows:

$$\begin{aligned}
 & \text{Max}_{\theta, z, \lambda, S} \theta \quad (7) \\
 & \text{s.t.} \\
 & \theta u_{jm} = \sum_{j=1}^J z_j u_{jm} - S_m, m = 1, 2, \dots, M, \quad (8) \\
 & \sum_{j=1}^J z_j x_{jn} + S_n = x_{jn}, n \in F_x, \quad (9) \\
 & \sum_{j=1}^J z_j x_{jn} = \lambda_{jn} x_{jn}, n \in V_x \quad (10) \\
 & \sum_{j=1}^J z_j = 1 \quad (11) \\
 & z_j \geq 0, j = 1, 2, \dots, J, \quad (12) \\
 & S_m \geq 0, m = 1, 2, \dots, M, \quad (13) \\
 & S_n \geq 0, n = 1, 2, \dots, N. \quad (14)
 \end{aligned}$$

The non-negativity constraint (equation 13) requires that slack variables are either zero, or a positive value. When the left hand side of equation 8 equals the first term on the right hand side exactly, the value of the slack variable is zero. However, when the left hand term is less than the summation on the right hand side, the slack variable takes on a positive value such that the equality constraint holds. Adding the slack variable (S_m) to each side of equation 8, yields the following for product m (Walden and Kirkley, 2000):

$$\theta u_{jm} + S_m = \sum_{j=1}^J z_j u_{jm} \quad (15)$$

The z_j variables are intensity variables which map out the linear segments of the frontier (Färe et al., 1994) and determine frontier output. These are sometimes referred to as "peers" in the Operations Research /Management Science literature. Therefore, adding the slack variable to the left hand side of equation 15 ensures that capacity output will be on the frontier.

DEA model outputs for the northeast region were total landings of each species divided by total days at sea to derive landings per day at sea. This was done to smooth out any peaks or valleys in the data. Estimated daily capacity for each vessel was then multiplied by an appropriate level of effort, or by the vessel's allocation of days at sea to yield an estimate of yearly capacity.

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